

9. The system of claim 7 wherein the electrical heating means comprises a coil wound around the end region, electric leads for supplying current to the coil so that the passage of current through the coil generates heat to the heat the end region.

10. The system of claim 1 wherein the system includes temperature sensing means for monitoring the temperature of the engine in the vicinity of the fuel injector for switching off the electrical heating means when the engine temperature reaches a predetermined temperature whereby sufficient heat is conducted from the engine to the end region to heat the fuel in the end region.

11. A fuel delivery system for a vehicle engine, having at least one cylinder, a piston moveable in the cylinder, and an air port for supplying air and fuel to the cylinder, comprising:
an inlet manifold for supplying air to the inlet port;

an injector port;
a fuel injector located in the injector port, the fuel injector having an end region and a body, the body including componentry for operating the injector; and
electrical heating means for heating the end region, but not the body of the fuel injector, to elevate the temperature of the fuel in the end region, so that when the fuel is ejected from the end region of the injector, the fuel substantially immediately converts to vapour because of the heating of the end region, and therefore the fuel in the end region, and the change in pressure experienced by the fuel as the fuel leaves the end region of the injector.

12. The system of claim 11 wherein electrical heating means is arranged on the outer surface of the end region.

13. The system of claim 11 wherein the electrical heating means comprises an electrical heating pad in electrical contact with the end region, an insulating member between the pad and the engine, and an insulated electrical conductor in electrical communication with the pad so that current is supplied to the pad and then flows through the end region to heat the end region.

14. The system of claim 13 wherein the electrical heating means comprises an insulated heating coil wound around the end region, and electrical conductors for supplying current to the coil so that the passage of current through the coil generates heat to heat the end region.

15. The system of claim 11 wherein temperature sensing means is provided for sensing engine temperature and for switching off supply of current to the electrical heating means when the engine temperature reaches a predetermined temperature sufficient to heat the end region of the conductor to the required temperature to cause the fuel to vaporise substantially immediately upon ejection from the injector.

16. A fuel injector for an internal combustion engine having a piston moveable in a cylinder, the injector comprising:

an end region;

a body;

electrical componentry in the body operable to enable fuel to be ejected from the end region of the injector; and

electrical heating means on the external surface of the end region for heating the end region of the injector, but not the body, so that when fuel is located in the injector and the electrical heating means operated, the fuel is ejected from the end region of the injector

REPLACED BY
ART 34 AMDT

and substantially immediately converts to vapour because of the heating of the end region and therefore the fuel in the end region, and the change in pressure experienced by the fuel as the fuel leaves the end region of the
5 injector.

17. The system of claim 16 wherein the electrical heating means comprises an electrical heating pad in electrical contact with the end region, an insulating
10 member between the pad and the engine, and an insulated electrical conductor in electrical communication with the pad so that current is supplied to the pad and then flows through the end region to heat the end region.

18. The system of claim 17 wherein the electrical heating means comprises an insulated heating coil wound around the end region, and electrical conductors for
15 supplying current to the coil so that the passage of current through the coil generates heat to heat the end region.
20

19. A fuel delivery system for an engine which has a combustion chamber, a piston movable in the combustion chamber, an air inlet port and an exhaust port,
25 comprising:

an injector port in the engine having a first open end communicating with the combustion chamber, and a second end remote from the first end, the injector port having an injector port wall;

30 a fuel injector located in the injector port, the fuel injector having an injector main body which houses electrical components for operating of the injector, an injection tip and an end region adjacent the tip, the end region being for storing fuel to be ejected from the
35 injector;

an electrical heating element surrounding the end region exterior of the fuel injector; and

REPLACED BY
ART 34 AMDT

an electric current supply for supplying current to the heating element for heating the end region of the injector to in turn heat the fuel in the end region so that when the fuel leaves the injector, the fuel

5 substantially immediately converts to vapor because of the heating of the fuel and the change in pressure experienced by the fuel when the fuel leaves the injector.

20. The system of claim 19 wherein the heating

10 element is provided in a cylindrical sleeve which locates over the end region of the injector, and sits between the end region of the injector and the injector port wall of the injector port in the engine.

21. The system of claim 19 wherein the current supply

15 comprises at least one conductor extending from the heating element to a current supply device.

22. The system of claim 21 wherein the current supply

20 device comprises a battery for supplying current and a pulse width modulator for modulating the current supplied by the battery so that the current supplied to the heating element is pulsed width modulated so that the amount of current supplied to the heating element can be controlled

25 to thereby control the heating of the heating element, and therefore the heating of the fuel within the injector end region.

23. The system of claim 22 wherein the current supply

30 includes a relay so that current is supplied when the relay is closed, and a control current supply for closing the relay.

24. The system of claim 23 wherein the control

35 current supply comprises a signal from a fuel pump relay which passes through an engine temperature sensor so that if the engine temperature is below a predetermined

REPLACED BY
ART 34 AMDT

temperature, the relay is closed to thereby enable current to be supplied to the heating element.

25. The system of claim 24 wherein the fuel injector includes a temperature sensor for monitoring the temperature of the fuel in the end region and for opening the relay when the temperature reaches a predetermined temperature.

10 26. An injector for injecting fuel into an engine, comprising:

an injector body having a tip, an end region adjacent the tip for storing fuel, and a main body portion in which electrical components for operating the injector are housed;

the end region having an outer surface formed from heat conducting material; and

a heater sleeve arranged on the end region and surrounding the end region, the sleeve including a heater element for receiving electric current to heat the heater element, and therefore conduct heat through the heat conducting outer surface of the end region into the end region of the injector for heating fuel in the end region of the injector so that when the fuel is ejected from the end region the fuel substantially immediately converts to vapor state because of the heating of the fuel and the change in pressure experienced by the fuel when the fuel leaves the injector.

30 27. The injector of claim 26 wherein the sleeve is formed from a high temperature silicon in which the heating element is embedded by molding.

28. The injector of claim 26 wherein the heating element comprises a coiled wire.

29. The injector of claim 28 wherein the coiled wire

REPLACED BY
ART 34 AMDT

includes a sheath which surrounds the coiled wire to maintain turns of the coiled wire separated from one another when the coiled wire is molded in the sleeve.

5 30. The injector of claim 26 wherein a temperature sensor is disposed adjacent the end region of the injector for monitoring the temperature of the end region of the injector, and therefore the fuel in the end region of the injector.

10

31. The injector of claim 26 wherein the heater sleeve includes a central opening having a peripheral wall for receiving the end region of the injector, and the temperature sensor is arranged between the end region of the injector and the peripheral wall.

15

32. A fuel delivery system for an engine which has a combustion chamber, a piston moveable in the combustion chamber, an air inlet port, an air inlet port and an exhaust port, comprising:

20

an injector port in the engine having a first open end communicating with the combustion chamber, and a second end remote from the first end, the injector port having an injector port wall;

25

a fuel injector located in the injector port, the fuel injector having an injector main body which houses electrical components for operating the injector, an injector tip and an end region adjacent the tip, the end region being for storing fuel to be ejected from the injector;

30

an electrical heating element for heating the fuel in the end region of the injector;

35

an electrical current supply for supplying current to the heating element for heating the end region of the injector;

a heat conducting path from the engine to the end region of the injector so the end region of the injector

- 39 -

REPLACED BY
ART 34 AMDT

can be heated by heat conducted from the engine;

a current shut-off for shutting off supply of current to the electrical heating element; and

whereupon initial startup of the engine, current
5 is supplied to the electrical heating element to heat the fuel in the end region of the engine, and after initial heating of the fuel in the end region, the current shut-off shuts off current to the engine so the end region is continued to be heated by direct conduction of heat from
10 the engine through the direct conduction path.

33. The system of claim 32 wherein the injector port is located in a manifold connected to the air inlet port and the direct conduction path includes a heat conducting
15 gasket between the inlet port and the manifold for conducting heat to the manifold and then to the end region of the injector.